THE SPORADIC-E FILES

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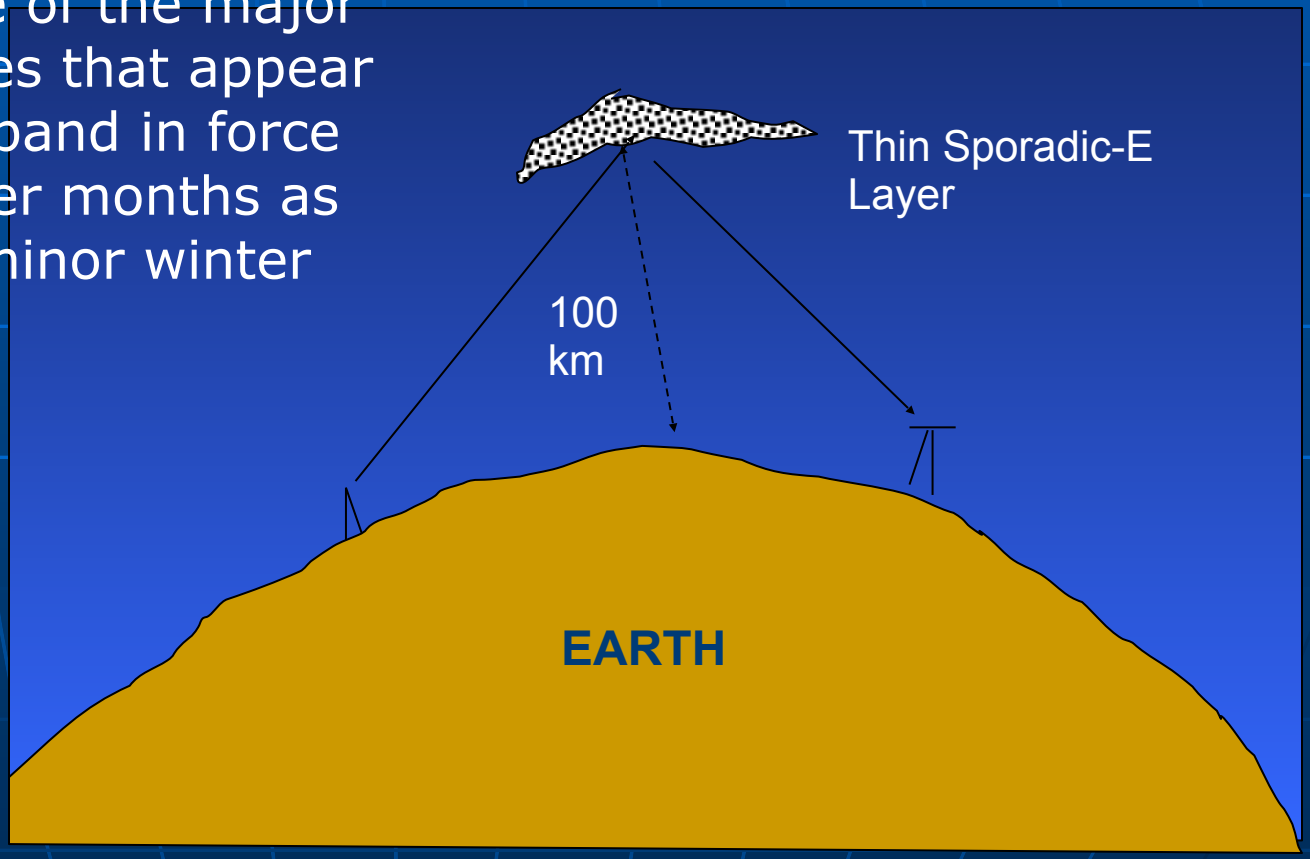
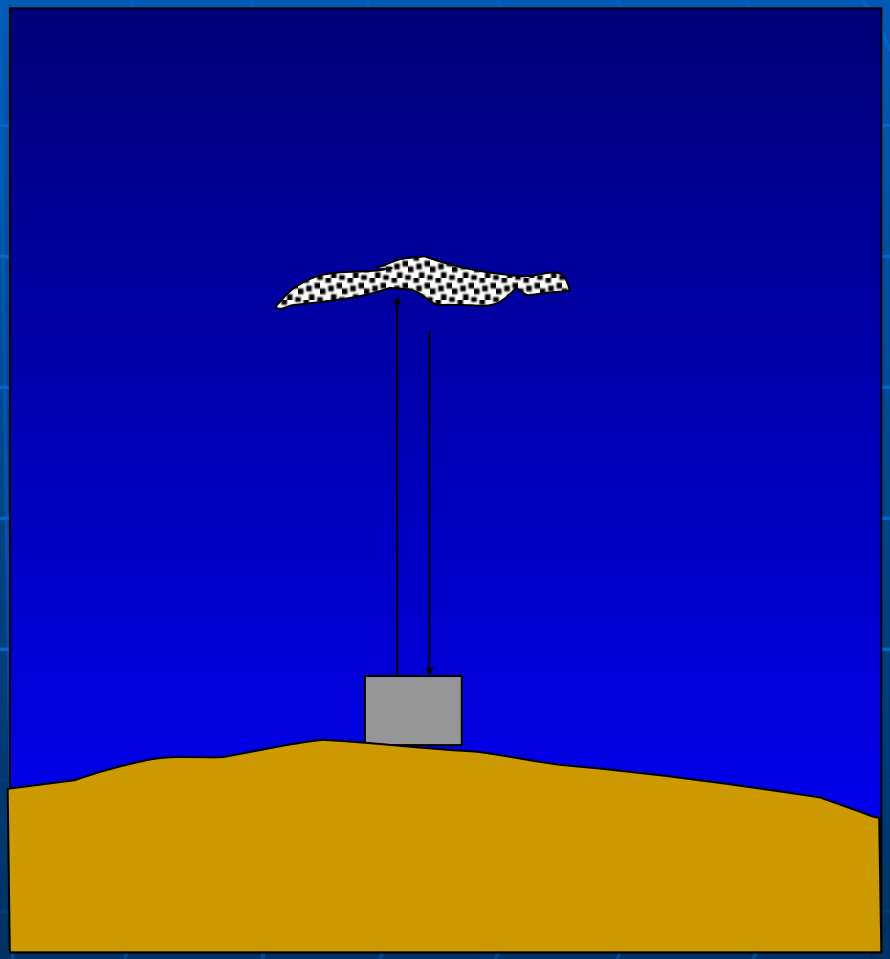
TOPIC # 1:

Introduction to an amazing VHF radio propagation phenomenon

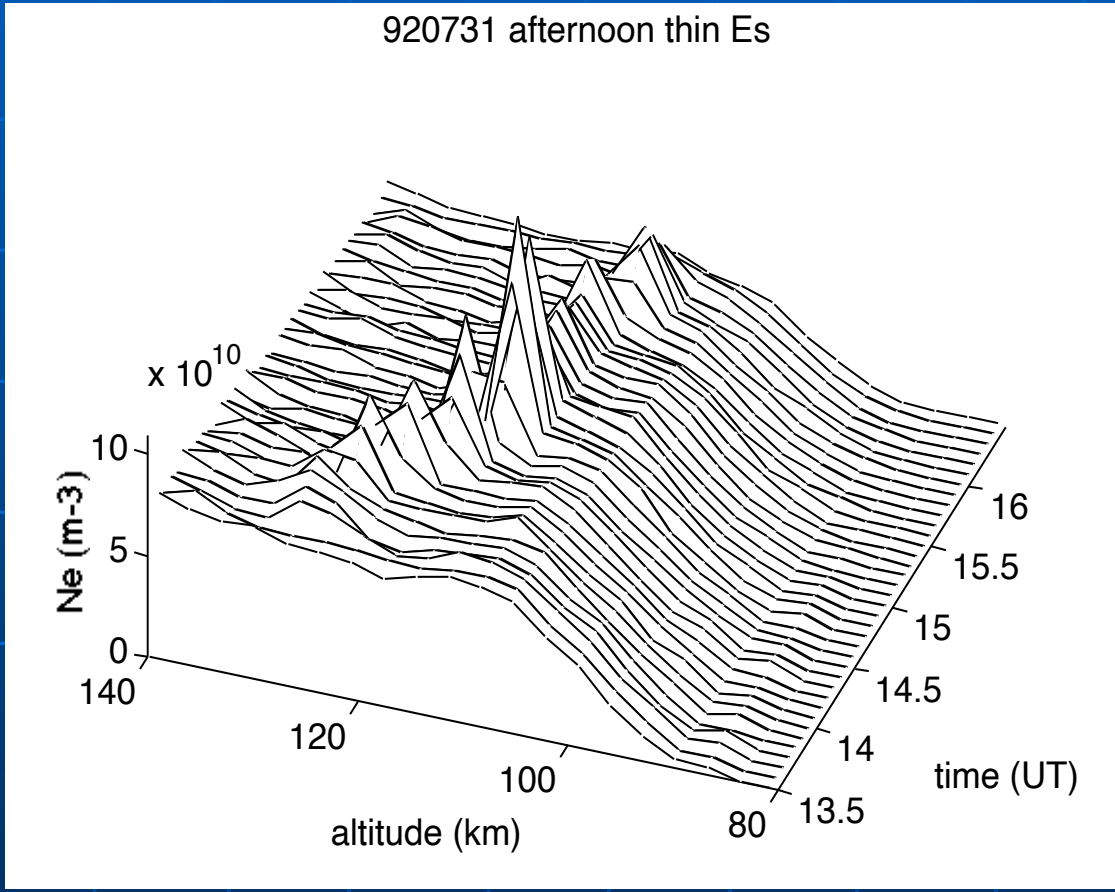
Sporadic-E has been the center of interest for both radio amateurs and scientists since its discovery on the Five Meter band in 1935. It is one of the major propagation modes that appear on the Six Meter band in force during the summer months as well as during a minor winter season.



Initially, Sporadic-E would be measured by ionosonde stations, that are located in different areas of the earth. These stations would send a sweep of frequencies vertically until a specific frequency (or critical frequency) is reflected back to the station. In subsequent years a series of rocket launches into active Sporadic-E formations would also take place.



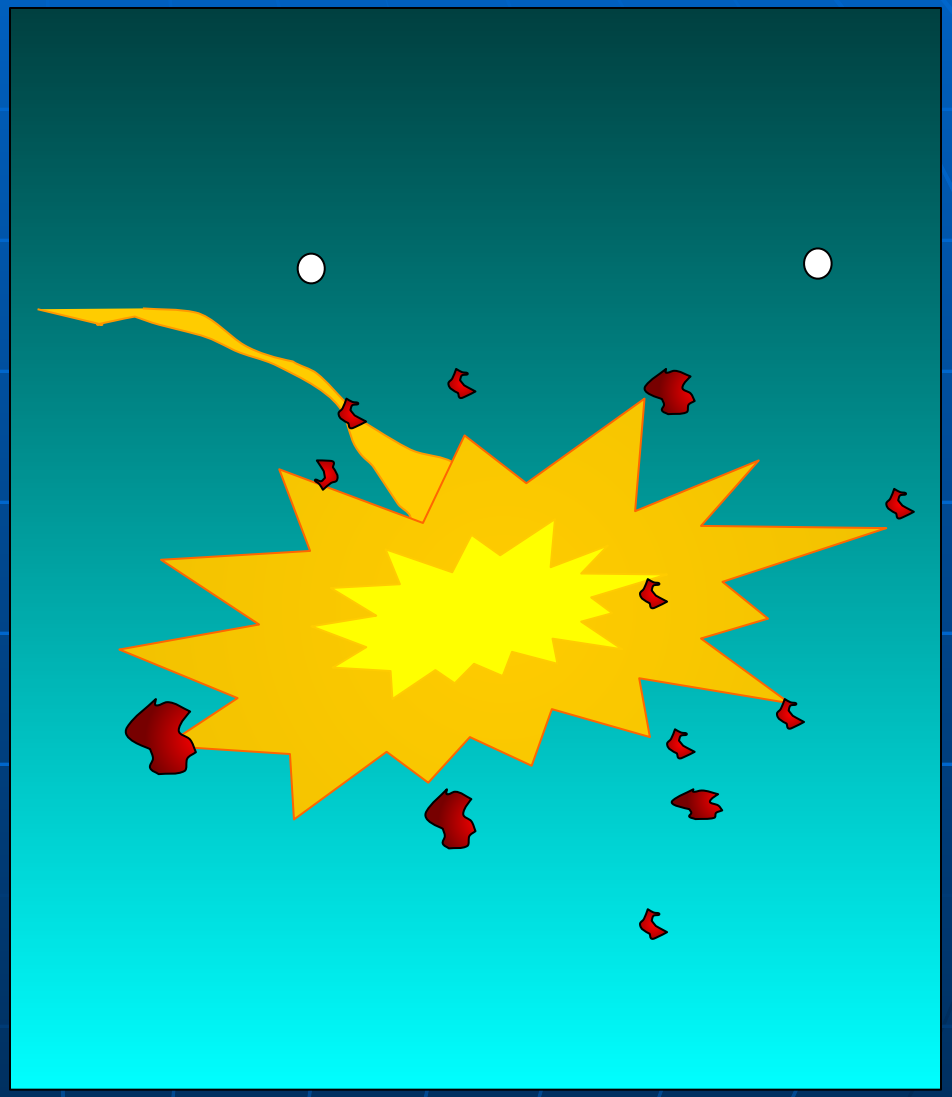
In recent years, additional methods for measuring Sporadic-E were developed, such as EISCAT radar and satellites. The plot below shows a thin Sporadic-E formation.



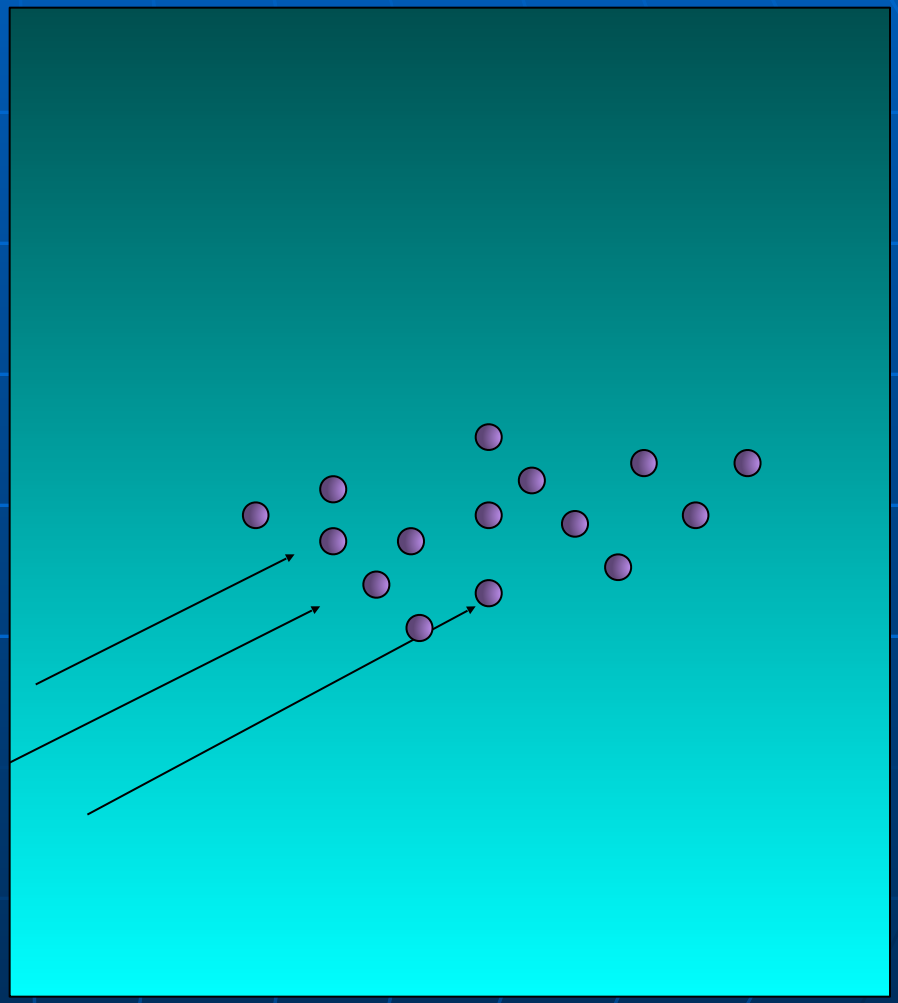
TOPIC # 2:

The basic mechanisms of the summertime Sporadic-E season

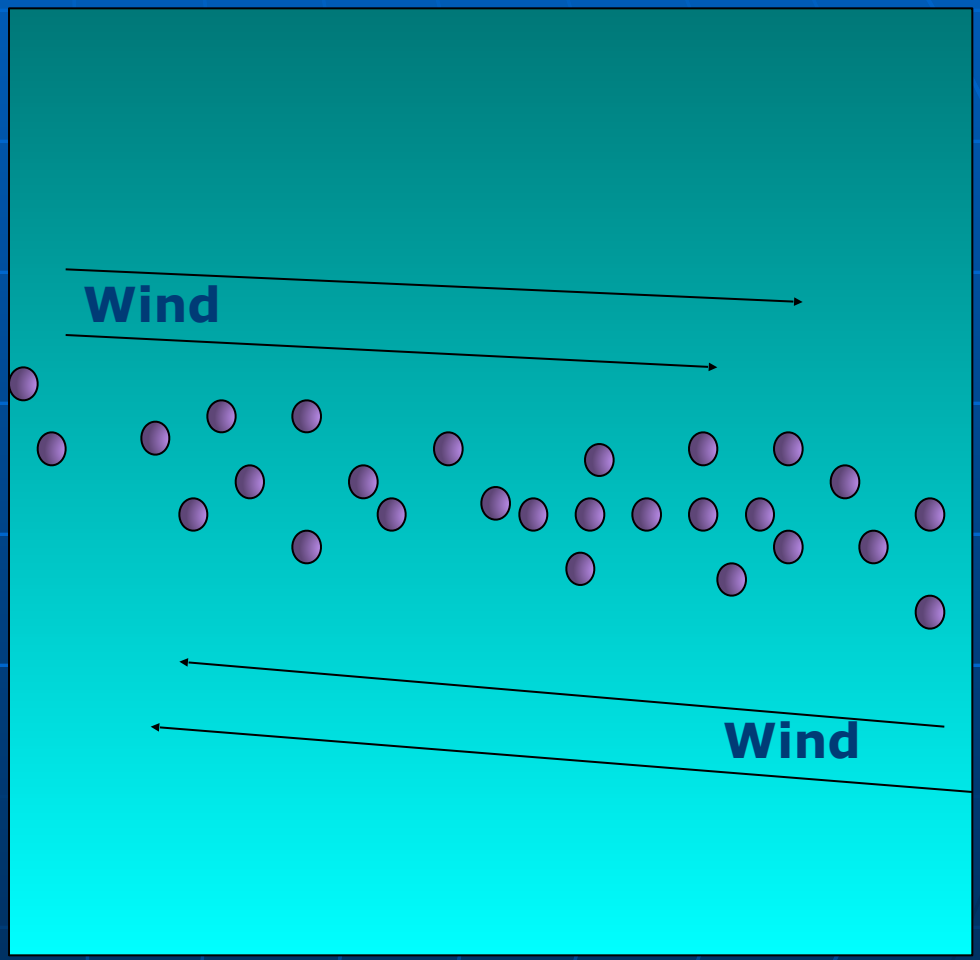
Sporadic-E ions originally come from the metallic particles (typically iron and magnesium) that result from meteor ablation in the E-region of the ionosphere. These particles will eventually fall down to the level of 90 km above earth.



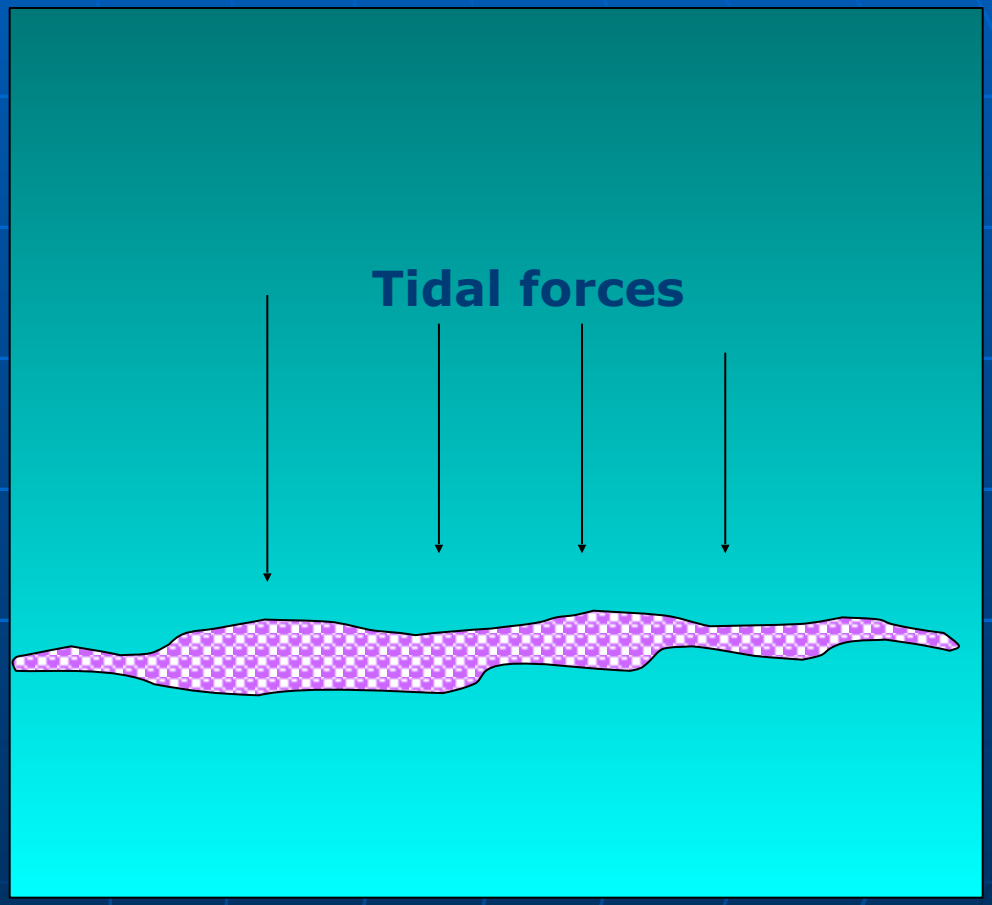
At around the height of 90 km, some particles are oxidized and fall down to earth while the remaining particles combine with existing oxygen ions (the oxygen ions are at their highest levels during the summer season). Ionospheric winds then transport these metallic ions upward into the E-region to above 100 km.



Between 120 and 100 km, the action of opposing ionospheric winds causes the effect of wind shear, resulting in the accumulation and compression of these particles into thin stratified layers. Each layer is like an invisible ion mirror that is capable of reflecting radio waves. As the density of the layer increases, higher frequency radio waves can be reflected.



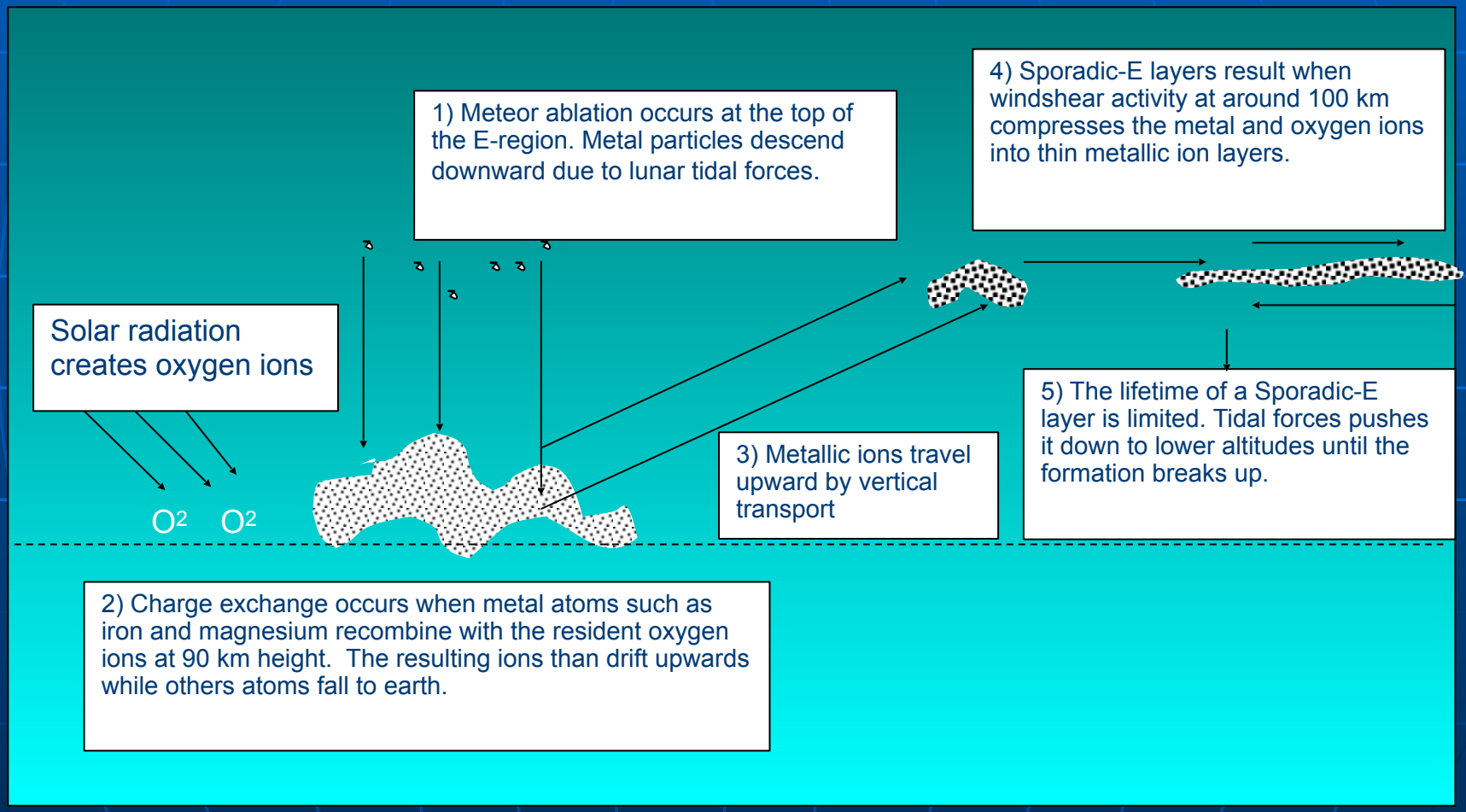
The lifetime of a Sporadic-E layer is limited, on the order of a few hours or more. This is because of the gravitational effects of tidal forces that push the layer down to the lower altitudes until it reaches 90 km and dissipates. Some ions are oxidized and fall to earth while others recombine with oxygen ions and again return into the E-region reservoir of ions.



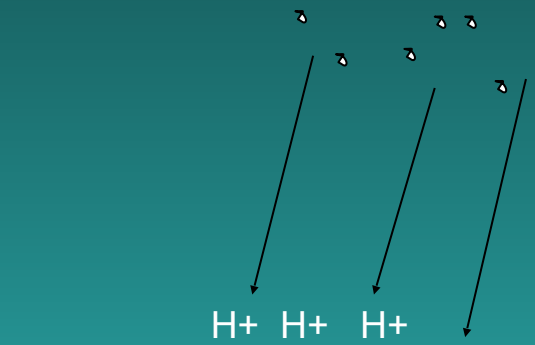
TOPIC # 3:

Comparison of Sporadic-E layer on Earth with other planets

METALLIC ION LAYER PROCESS ON EARTH



METALLIC ION LAYER FORMATION PROCESS ON JUPTIER



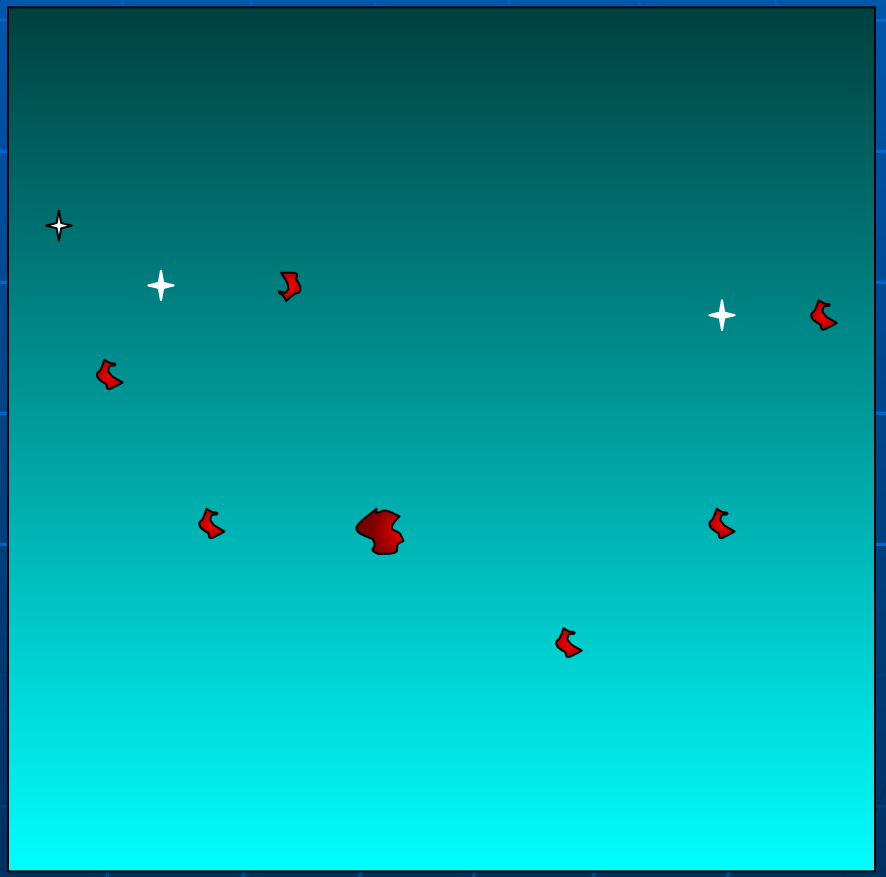
1) As meteor ablation occurs, charge exchange occurs immediately between the metal atoms and the resident hydrogen ions at 400 km due to high incident speed caused by gravitational acceleration.

2) Metallic layers are directly formed from the resulting metal ions of magnesium and iron.

TOPIC # 4:

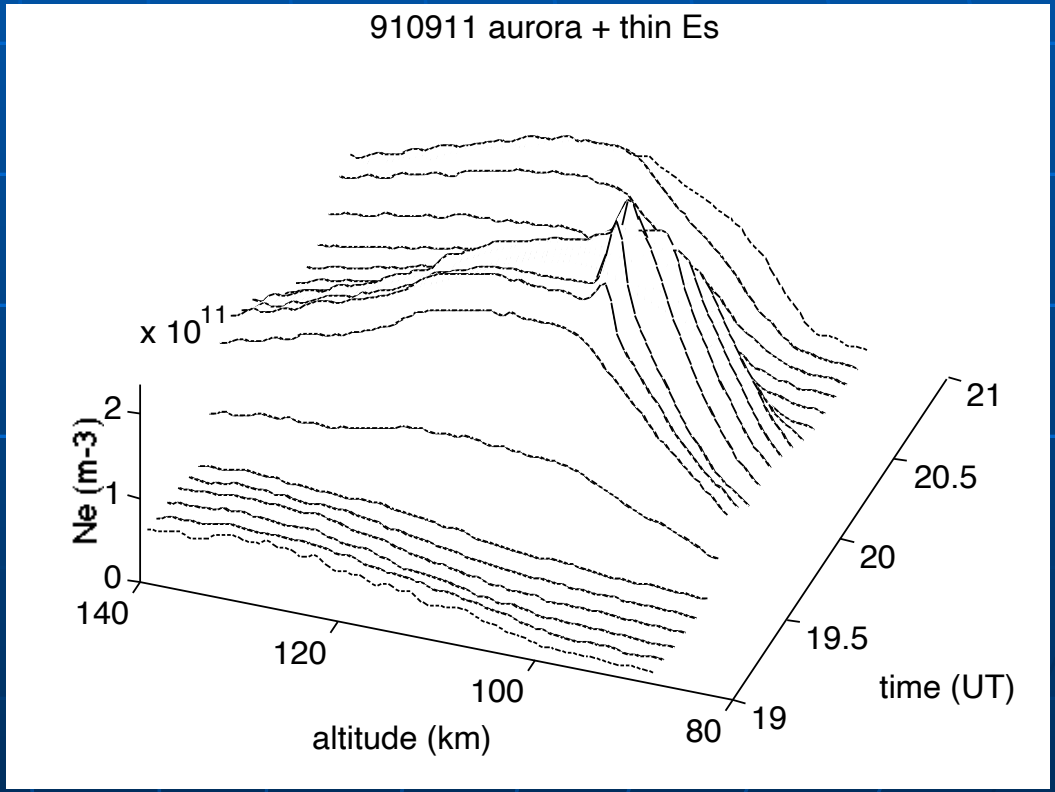
Why is there a lack of Sporadic-E during March and September?

There is a significant lack of Sporadic-E activity during the equinox months of March and September. One possible factor that may be involved for this situation is the reduced level of oxygen ions in the 80 to 100 km region of the ionosphere as compared to the summer months. This will result in less metal ions being created at the 90 km level, meaning that most metal particles will oxidize and fall to earth.

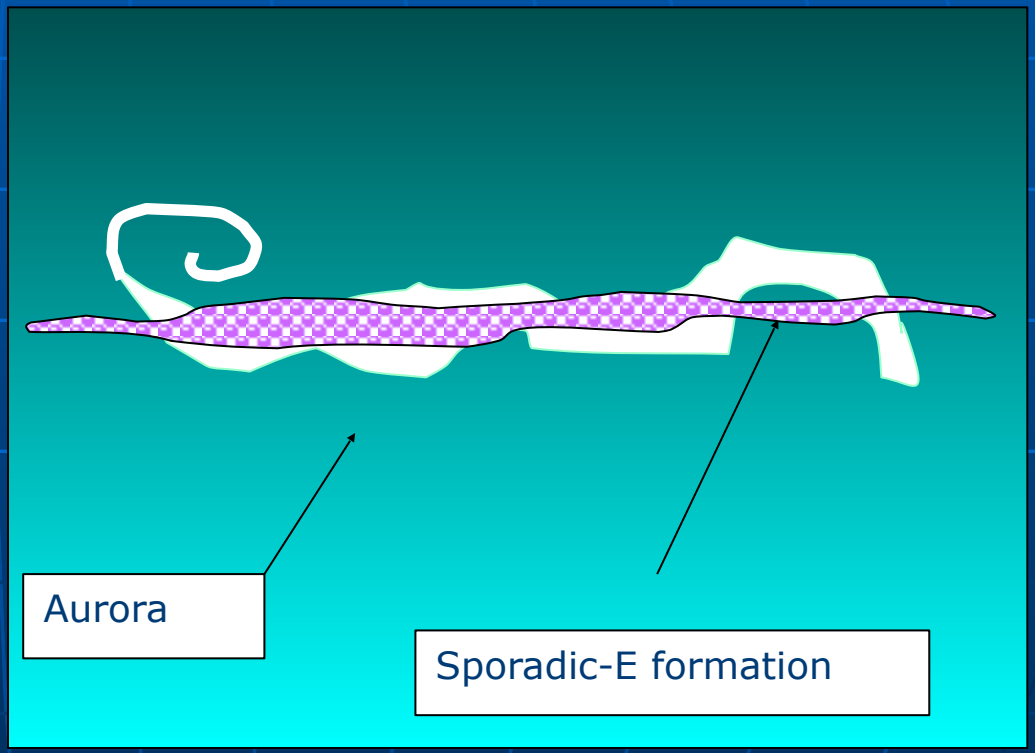


However, this factor alone cannot account for the near-total disappearance of Sporadic-E during these months.

EISCAT radar plots show some cases at high latitudes show where Sporadic-E formations seem to be embedded inside aurora formations. In some cases, this can develop into Aurora-E. It is suspect that aurora formations may actually block the presence of Sporadic-E during these months.



Indeed, the unique signals of aurora-E formation have often been observed on the Six Meter band after a particularly intense aurora opening.
Looking at EISCAT radar plots of these formations, it has been observed that Sporadic-E formations are embedded inside the aurora formation and will eventually dissipate inside the aurora.



There would appear to be a reduction of resident Sporadic-E ions in the E-region during the period of the equinoxes because of the increased presence of aurora along with other associated factors related to the magnetic field lines. As a result, very few Sporadic-E openings are observed during the equinox period.